Title: Evaluation of Exclusion to Prevent Indoor Infestations of the Brown Marmorated Stink Bug

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Abstract: Brown Marmorated Stink Bugs (BMSB) are invasive insects that damage plants outdoors and overwinter inside structures. Pest management professionals receive calls about this and other overwintering pests in the spring and fall, when pests attempt to exit and enter structures, respectively. Restrictions on where pesticides can be applied and the timing of applications for effective control complicate prevention of indoor overwintering pest problems using insecticides. Furthermore, once pests are indoors, there is not much to be done. Technical resources often indicate that long-term management of overwintering pests can be achieved through physical exclusion around doors and windows. However, the scientific data to support this recommendation is lacking.

The goal of this project is to evaluate the effectiveness of physical exclusion in preventing Brown Marmorated Stink Bugs from entering condominiums in Hartsdale, NY. Twenty-two homeowners agreed to participate in the study, constituting 11 pairs of adjacent units. In a pre-study survey, 83% of residents considered stink bugs to be a moderate to major problem in their homes, and many were concerned about their presence in living spaces. Gaps around windows and doors of half the units (11) were closed using a standard sealant in July 2015, and two insect light traps were installed in all homes at the beginning of September. One trap was installed in the living space in areas where residents previously detected stink bugs, and the second trap was installed in attic spaces. Traps were monitored monthly from September to November and the number and identity of trapped insects was determined at the end of this period. By December 2015, a total of only 6 overwintering insects (4 BMSB, 1 Western Conifer Seed Bug, 1 Multicolored Asian Ladybird Beetle) were collected from all 22 units, limiting analysis. This research will continue into the fall of 2016.

Background and Justification: The Brown Marmorated Stink Bug, *Halyomorpha halys* (Stål) (Hemiptera: Pentatomidae), is an invasive insect from Asia that was accidentally introduced to the United States near Allentown, PA (Hoebeke and Carter 2003). Since its original discovery in the 1990s, this pest has dramatically expanded its range and population size, and can now be found in 41 US states and Canada (Rice et al. 2014).

Brown Marmorated Stink Bugs (BMSB) use piercing/sucking mouthparts to feed on over 100 different host plants (Bergmann et al. 2013), including ornamental and landscape plantings, agricultural crops and wild or woodland plants. Feeding by BMSB can cause physical damage to crops, resulting in economic losses (Bergmann and Raupp 2014). In 2010, for example, the apple industry reported losses totaling $37 million due to BMSB damage (Leskey et al. 2012a).

For urban pest professionals, BMSB are a problem when they enter buildings as overwintering pests. Decreasing day length and temperatures cue BMSB to migrate to overwintering sites, including human structures. Once they land, BMSB climb upward and seek dark cracks and crevices, locating other stink bugs by detecting aggregation pheromones (Toyama et al. 2006; 2011). Stink bugs remain hidden until warmer temperatures cause them to explore outside of their harborage. If on a warm winter afternoon, bugs inside homes may be attracted to the light of windows during the day, and artificial lights at night (Inkley 2012). Light emitted from reading lamps, computers, tablets, and televisions at night are attractive to stink bugs, bringing them into close contact with homeowners and causing distress. In the spring, when temperature and day length increase, overwintered BMSB leave homes and return outdoors to feed and reproduce.

Management of BMSB, both in agricultural and urban areas, has relied on insecticide applications to kill all life stages (Leskey et al. 2012b), and is particularly effective against nymphs and overwintered adults (Leskey et al. 2013). However, many products currently employed to control BMSB have reduced efficacy over time (Leskey et al. 2013), while label changes to pyrethroids limit how these products can be applied by urban pest management professionals.

Physical exclusion is often promoted as a practice to reduce pest numbers indoors. Sealing cracks and crevices around doors, windows, utility access points, chimneys, siding and fascia have been promoted in extension bulletins and technical guides for BMSB (Day et al. 2011) and other overwintering pests. Despite its purported efficacy, to date there have been no scientific evaluations of pest exclusion, nor easy guidelines on how to implement this technique. Therefore, the goal of this project is to scientifically evaluate the use of physical exclusion to prevent invasion of BMSB and other overwintering pests. Results of this project may provide guidelines for pest professionals that could be used to create an exclusion add-on service to existing overwintering pest treatments.

Objectives:

a. Evaluate the ability of physical exclusion to reduce the number of Brown Marmorated Stink Bugs (and other overwintering pests) that enter homes.
b. Document, demonstrate and educate on how to implement physical exclusion for homeowners and pest professionals.

Activities:

a. This study is being conducted at a condominium complex in Hartsdale, NY where residents have complained of high BMSB populations for the last several years. The complex includes mature trees both among the buildings and on the periphery of the property. Furthermore, the complex is adjacent to a nursery and farm that produces several BMSB host plants, which might contribute to high number of stink bug complaints.

   Within the complex, two to four individual units (condominiums) are joined to form a block. This building design is ideal to test exclusion for a pair of units within a block, such that one unit will undergo pest exclusion while the other will not.

Physical exclusion using an appropriate exterior sealant around windows and doors was completed in July 2015. To evaluate pest exclusion, BMSB populations will be monitored (counted) indoors using Catchmaster GLOStik Flying Insect Traps in attics, and Catchmaster SilenTraps in living spaces of twenty-two units (11 with exclusion/11 control). Traps were run from September to November during the invasion window, and will be run again from March to May as insects attempt to leave overwintering sites.

Residents completed a pre-study survey to document their experience with BMSB the previous year, including a subjective rating of the nuisance level of this pest. Treatment units will be inspected in June/July 2016 to document the durability of materials used after one year. Stink bug populations will be monitored again from September to November 2016, and residents will be surveyed at the end of the experiment to determine their experience with BMSB. This 18-month study period allows for evaluation of pest exclusion during two fall invasion events and one spring emergence event.

b. The results of this study will be useful for homeowners, pest professionals and extension personnel. Therefore, a summary of the project and its findings will be submitted to a trade publication, such as PCT Magazine, in November 2016 to coincide with the final report. A fact sheet or Prezi will also be made available for download from the New York State IPM Program's website, similar to the format used for outreach on bed bugs (see resources on the "What's Bugging You?" bed bug page). If the experiment shows that physical exclusion is effective at preventing BMSB infestations, a short educational YouTube video will be created to demonstrate the techniques utilized. Finally, information will be made available on the Scientific Coalition on Pest Exclusion's forthcoming website (www.pestexclusion.org).

Results and discussion:

Resident responses to the survey corroborated reports that stink bugs have been an ongoing problem at the condominium complex (Figure 1). For example, only one resident indicated that they have never observed stink bugs in their home. In addition, residents considered stink bugs to be a moderate to major problem, with half of the residents indicating that they observe ten or more bugs each year (Figure 2). Residents also identified a number of concerns that they have about stink bugs. For instance, residents indicated that bugs were found in areas where they sleep and sit, but were not aware of why. Further, one resident indicated that they do not want their neighbors infestation to affect their home, while another resident indicated that "typical sprays do not kill the stink bugs." These responses will be useful when developing educational materials to address knowledge gaps.

Although traps were operated from September to November in 2015 in 22 units, a total of only 6 overwintering pests were collected. This included four BMSB, one Western Conifer Seed Bug, and one Multicolored Asian Ladybird Beetle. Of those collected, one BMSB and the seed bug were from homes where exclusion work had been performed. Because of the low number of insects captured, statistical analysis of this data was not

possible. Traps will again be operated in the spring and fall of 2016, providing additional opportunities to trap overwintering pests and evaluate the effectiveness of exclusion.

It should be noted that recent presentations about stink bugs have suggested that populations are lower in recent years in the Northeast (Medical and Urban Entomology session at the Eastern Branch of the Entomological Society of America; 1/4/2016, Philadelphia, PA). Several hypotheses exist to explain this phenomenon, including the accidental introduction of a native egg-parasitoid natural enemy of BMSB, *Trissolcus japonicus* (StopBMSB website). This observed reduction in pest populations could explain why few stink bugs were captured in the fall 2015 collection.

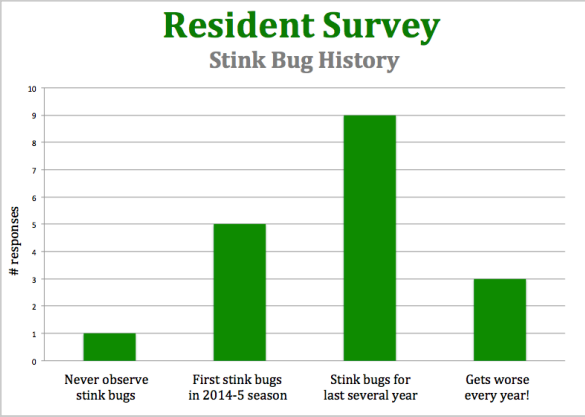

Figure 1. Resident responses to a question about the history of stink bugs in their unit.

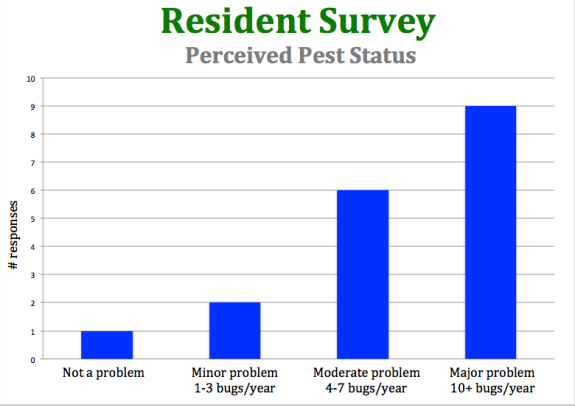

Figure 2. Resident responses to the overall pest status of stink bugs in their unit.

Project locations:

This study is taking place at a condominium complex in Hartsdale, NY.

Presentations:

Date	Title and type of presentation	Location	Audience	# of people; duration
1/14/16	New Arrivals: Emerging and Invasive Pests [National Pest Management Association Eastern Conference]	Pocono Manor, PA	Pest professionals and industry representatives	60; 1 hour

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